Organic Farming in the Tropics and Subtropics

Exemplary Description of 20 Crops

Tea

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The cultivation guidelines are available in English, Spanish and German for the following crops:

banana, brazil nut, cashew nut, cocoa, coconut, coffee,
cotton, hibiscus, macadamia, mango, papaya, peanut,
pepper, pineapple, sugar cane, sesame, tea, vanilla.

The cultivation guidelines for Bananas, Mangoes, Pineapples and Pepper were revised in 2001 for the United Nations Conference on Trade and Development (UNCTAD) by Udo Censkowsky and Friederike Höngen.

In 2002 two more guidelines, for rice and date palms, were published in English.

All the authors emphasize, that the cultivation recommendations at hand can just provide general information. They do not substitute technical assistance to the farmers with regard to the location.

All indications, data and results of this cultivation guidelines have been compiled and cross-checked most carefully by the authors. Yet mistakes with regard to the contents cannot be precluded. The indicated legal regulations are based on the state of the year 1999 and are subject to alterations in future. Consequently all information has to be given in exclusion of any obligation or guarantee by Naturland e.V. or the authors. Both Naturland e.V. and authors therefore do not accept any responsibility or liability.

Furthermore the authors kindly call upon for critical remarks, additions and other important information to be forwarded to the address below. The cultivation guidelines will be updated regularly by Naturland e.V.

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Organic Cultivation of Tea

1. Introduction

1.1. Botany

The tea bush (*Camellia sinensis* (L.), O. Kuntze) belongs to the Thecae family. It originates from the high regions of such countries as South west China, Myanmar and North east India.

1.2. Varieties and countries of origin

The tea varieties that are cultivated are all hybrids of the original tea plant *Thea sinensis* and *Thea assamica*. The results gleaned from studies of conventional varieties can at least be used in part (e.g. as regards quality parameters and resistance properties). Until now, though, there have been no studies of varieties for the organic cultivation of tea. For this reason, only generalised recommendations can be offered:
Organic cultivation of tea requires varieties (clones) with broad-scope resistances, and the ability to thrive under shade trees (upright, dark green leaves).
Organically cultivated tea was first produced in 1986 in Sri Lanka. Since then, it has become wide-spread mostly in India and Sri Lanka. Currently, around 5000 ha of tea are being cultivated organically. (Other producing countries include: China, Japan, Seychelles, Tanzania, Kenya, Malawi and Argentina).

1.3. Uses

Primarily, tea is drunk as **black tea**. Other sorts with less importance to the worlds market are **green tea** (East Asia, Arabian countries) and **Oolong-tea** (China, Taiwan). Recently, organic green tea is manufactured in increasing quantities. I**nstant tea** has also begun to be manufactured in increasing quantities.

2. Aspects of plant cultivation

2.1. Site requirements

The ideal growth conditions for tea are average annual temperatures of 18-20°C, an average daily amount of sunshine of 4 hours per day, as well as a minimum of 1600

mm of rainfall distributed evenly throughout the year. Relative humidity should lie between 70% and 90%. In regions with extensive dry seasons, shading trees play an
important role in providing and maintaining sufficient humidity. Additionally, tea plantations in windy regions should also be protected by wind breakers e.g. hedges, to reduce the intensity of evapo-transpiration (whereby, for example, in the dryer regions of East and Central Africa, these can then also begin to compete with the tea bushes for the available supplies of water).
The soil should be deep, well-drained and aerated. Nutrient-rich and slightly acidic soils are best (optimum pH-value 4.5-5.5). Sufficient drainage and aeration of the soil can be lastingly and economically achieved with the combination of shading trees and deep-rooting green manure plants.
China tea (*C. sinensis var. sinensis*) is especially suited to hilly regions. It is resistant to drought, and can tolerate short periods of frost (yet only has a low tolerance of shade). Contrastingly, Assam tea (*C. sinensis var. assamica*) is a purely tropical crop, and reacts sensitively to drought and the cold (yet only has a high tolerance of shade).

2.2. Seeds and seedlings

On organic cultivations, **no gen-manipulated varieties are allowed**. Tea plants are propagated both generatively or vegetatively. Cultivation takes place under controlled conditions in special beds over the space of 2-3 years. It is recommended to establish own nurseries in the tea garden, in order to ensure a continuous supply of untreated and healthy plants.

In choosing locations for the nursery, the following should be considered:

- A protected site
- Sufficient supply of water
- A site that has not been cultivated, if possible (virgin soil)
- Preparation of the site with legumes
- (1-2 years, e.g. with Crotalaria ssp., Tephrosia candida, that are afterwards mulched)
- Natural shade (e.g. Tephrosia candida, Crotalaria ssp., Sesbania ssp.)
- Same altitude and site conditions as the tea garden (in case it is purchased as an addition)

2.3. Planting methods

There are different methods applied depending on the site: single plants, double plants or the hedge planting method.

When establishing a new tea plantation, care should be taken to manually uproot problematical grasses, such as e.g. Alang-Alang (*Imperata cylindrica*). Subsequently,
it is recommended to plant fast growing covering plants (e.g. Sarawak bean *Vigna hosei*, Creeping Indigo *Indigofera spicata*, Guatemala grass *Tripsacum laxum*), to suppress the growth of unwanted species of flora. In particular, when the tea is to cultivated on terraces, the soil should be protected against drying out by green manure plants (such as weeping lovegrass *Eragrostis curvula*). New tea plantations, especially those planted on slopes, are at the greatest risk of erosion taking place, which will lead to soil degradation and nutrient losses.
Plantations set on slopes (e.g. Darjeeling) should therefore be planted along the contour lines. Slopes and peaks that are especially at risk from erosion should not be used to cultivate tea. Rather, these areas should be protected by planting permanent forests along them.
Between 10,000 and 20,000 plants per hectare can be planted, depending on the gaps between rows and plants. The crop density should always be adapted to the site conditions (slope, altitude, micro-climate etc.), as well as incorporating those shading trees necessary on organically cultivated tea plantations.

Shading trees have a great importance to the organic cultivation of tea. The following is a list of their positive effects:

- Nutrient supply (e.g. nitrogen, when legume shading trees are used; they retrieve nutrients from lower soil levels; reduction of nutrient losses from washing out)
- Build-up of humus
- Protect the tea bushes from too much sun (yield reductions are possible when the solar radiation is too intense, and there is a lack of shade)
- Reduction of erosion through wind and rain (and damage from hail)
- Influences the quality of the tea
- Positive micro-climatic effects e.g. during drought periods
- Encourage benefical insects to settle
- Create a pleasant atmosphere for the pluckers.

When choosing tree varieties to use as shading plants, it is important to use plenty of local, adapted varieties, enough leguminous trees, and overall, a wide variety of differing species. Care should be taken to choose fast, and not so fast growing varieties of shading trees at the beginning of cultivation. The correct combination of shading tree varieties should always be based on local experience, or, in certain cases, tried out on site.
As regards the number of shading trees or the intensity of shade required, the following rule can be used as a guide: The higher the tea garden is located, the less shade is necessary (and also the other way round).

2.4. Diversification strategies

Which types of other crops can be integrated into the tea plantation needs to be decided for each individual production site. Species which should be considered include those which can provide food for worker's families, be sold on the local market or used as additional cash crops. The cultivation of spice plants, such as, e.g. cardamom and ginger (Darjeeling) or nutmeg nuts and pepper (Sri Lanka) are worth mentioning. Vanilla can also be easily integrated into organic tea plantations (the vanilla plants will climb up the shading trees). Furthermore, also the wood of shade trees can be used as fuel or building material.

2.5. Supplying nutrients and organic fertilisation management

2.5.1. Nutrient requirements

A high amount of nutrients are lost through the continual plucking of tea leaves. The following table provides average nutrient losses on various tea cultivation regions, which are based on studies carried out on conventional tea plantations (therefore, the values can only be approximately used for the situations on organic tea plantations):

Extraction in kg for 1000 kg tea/ha/year (conventional tea gardens):

Region	Nitrogen (N)	phosphate (P_2O_5)	Potassium (K_2O)
North India	50	10	20
South India	65	15	35
Sri Lanka	45	8	21
East Africa	42	6-8	24

The plant material that accumulates throughout a pruning cycle also contains high levels of nutrients (for a 3-year cycle):

Loss (kg/ha) over years	Nitrogen (N)	phosphate (P_2O_5)	Potassium (K_2O)
Pruning	785	135	570

Moreover, the perennial tea plant requires a considerable amount of nutrients in order to develop roots, stem and branches.

2.5.2. Organic fertilisation management

At the start of the conversion, the tea garden needs to be developed consequently and in stages from a monoculture towards a diversified crop system. Alongside the cash crop tea, plants should be cultivated to improve soil fertility, provide a supply of

nutrient (especially nitrogen), increase diversity (habitats for benefical insects), supply wood (fuel and building material) and (if practised) to provide feedstuff for on-farm animal husbandry.
Main objective is to provide a sufficient supply of organic matter for the tea bushes. Spreading the organic matter over the site should be given preference to the more work-intensive practise of composting.
The following sources of **nutrient supplies** are available:

A. Litter fall and pruning material from shade trees:
Litter is provided without any additional work. Additional working hours need to be calculated for pruning the shade trees (to create an ideal micro-climate, admit light and control the growth of th tea bush).

The following nutrient contents of litters applies to siran (*Albizzia chinensis)*:

Nutrient (kg/ha)	Minimum	Maximum
N	50,2	125,5
P_2O_5	17,6	44,0
K_2O	14,2	35,5
CaO	25,5	63,5
MgO	12,4	12,4

The number of shading trees varies according to site and the variety of tree (up to 500 shading trees per hectare). The pruning material should remain as mulch directly on the site, or, if applicable, used as compost material. Yet if the pruning material is to be used as fuel, at least the ashes should be used as a compost supplement (e.g. to replace the potassium).

Three aspects need to be heeded, in order to create the conditions necessary for the soil life to continue decomposition :

- The pruning material needs to be sufficiently chopped (2-5 cm pieces).
- The material must then be evenly spread around the tea bushes (avoid creating heaps of material).
- The carbon-rich material needs to be mixed with additional nitrogen-rich material (e.g. neem-press cakes, castor cake or green manure from crotalaria). In order to achieve a better carbon/ nitrogen ratio for successful decomposition.

Proliferation of different varieties of shade trees in various tea cultivation region

Northeast India	South India/ Sri Lanka	Indonesia	East Africa
Albizzia chinensis *Albizzia odoratissima* *Dalbergica assamica* *Derris robusta* *Erythrina indica*	*Erythrina ssp.* *Gliricidia ssp.* *Grevillea robusta*	*Albizzia chinensis* *Albizzia moluccana* *Albizzia falcata* *Erythrina ssp.* *Leucaena glauca*	*Grevillea robusta* *Albizzia gummifera* *Albizzia adiantifolia* *Gliricida maculata*

B. Green Manure (mulch):

The foliage from green manure plants, as well as that from the other crops, should remain as mulch material on the site. In the cases of tea gardens where integrated animal husbandry is practised, care should be taken to choose green manure plants that can also be used as fodder crops.

Plant variety	Peculiarities
Paspalum purpureum (Napier fodder grass)	Fodder grass during early stages, mulch, erosion and wind protection rows
Tripsacum laxum (Guatemala Grass)	Fodder grass, mulch, strengthens soil coherence
Crotalaria anagyroides (rabbit bells)	Hardy and rapid growth, suitable as fodder, legume
Crotalaria ssp.	Annual and perennial, green fertiliser, covering plant, partly suitable for use as fodder
Indigofera spicata (creeping indigo)	Covering plant for new tea plantations, non-climbing, perennial, legume
Vigna hosei (Sawara bean)	Covering plant for new tea plantations, suitable as fodder, legume
Thephrosia candida	Perennial; green manure; legume; use up to 1200 m height; good biomass production even on poor soils;
*Leucaena leucocaephala (*Horse tamarind)	Drought and salt resistant; legume; limited use as fodder;
Sesbania ssp.	Drought and salt resistant; legume; use as fodder

C. Returning Pruning material from tea bushes:

As already mentioned, the pruning material from the tea bushes contains a considerable amount of nutrients (especially after deep pruning and/or rejuvenation).
These nutrients should not be removed from the tea garden (e.g. as fuel), but should either be re-applied directly as mulch, or via composting (same as shading trees).

D. Composting and animal husbandry:

On many tea gardens, the people living and working there are often supported in their acquiring and maintaining of, e.g., cattle, as they are thereby assisted in an opportunity to supplement their income. The basic source of fodder for the animals comes from fodder and green manure plants (e.g. Guatemala grass), vegetation in the tea garden‘s edges, which are not planted with tea, or from plants neighbouring the tea garden. The space available to grow fodder must be taken into consideration when calculating the number of cattle to acquire. If the tea‘s nitrogen demand (on average around 60 kg) is to be met entirely from composted cattle manure, around 2 cattle per ha of cultivated tea are required.

E. Ditch composting method:

For this method, small ditches are dug between alternating plant rows every 3-4 years, and filled with pruning material, green manure plants, compost and cattle dung (the organic material must be well cut-up, and should not be buried too deep). Simultaneously, the tea bush roots are also cut to stimulate new growth. The disadvantage of this method is the high workload involved – especially on older plantations with narrow gaps between the rows.
It is therefore vital for the tea plantation‘s manager to establish a fertilisation programme right at the beginning of the conversion, that places core emphasis on the production and subsequent usage of organic substances, as the most important source of nutrients.
Furthermore, the nutrient content of the soil should be analysed regularly, particularly the supply of potassium, phosphorous and magnesium (also for trace elements). Should deficiencies arise, additional fertilisers, approved for use on organic plantations, are available for sale (e.g. rock phosphate, potassium sulphate, kainit and sylvit). In order to maintain an ideal pH value, liming (e.g. with dolomite meal) may be necessary. In the case of extremely low pH values (risk of Al toxicity), the use of gypsum ($CaSO_4$) is also permitted.
The purchase of additional organic fertilisers may be necessary particulary during the first stages of the conversion period (during the first 3-6 years, depending on the site). In any case, the purchase of any additional organic fertilisers must first be approved by the certification body. The preparations generally used on tea

cultivations include, e.g., neem press cakes, castor cake, coconut press cakes or dung from extensive animal husbandry.

Tea plantations which are not capable of providing sufficient amounts of compost from organic materials produced on site are permitted to purchase certain organic materials from outside (after approval by the certification body). These include; neem press cakes, castor cake, bone meal, coconut press cakes and cattle dung from extensive animal husbandry.

2.6. Biological methods of protecting plants

Experience has shown that the frequency of disease and pest infestations decreases with during the conversion process. Yet this requires all of the necessary requirements to be fulfilled (encouragement of beneficial insects, micro-climate etc.).

The following is a list of counter-measures against infestation by disease or pests that are currently being utilised:

Pest/ disease	**Biological counter-measures**
Exobasidium vexans (blister blight); Endemic to Southeast Asia, does not occur in East Africa;	Copper preparations[1] permitted in emergencies (max. 3kg pure copper per ha); Preventive measures (micro-climate, hygiene precautions etc.) important!
Poria hypolateritia (Red root rot)	Tearing out and burning of infested tea bushes.
Meloidogyne ssp. (Nematodes)	Remove infested tea bushes, and remove and replace large amounts of the soil; Prevention e.g. using plant-bags in the seed bed; use shading tree *Indigoferra teismanii* as a trap plant; Sow *Tripsacum laxum* (Guatemala grass) before starting a new plantation.

[1] According to the European Regulation for Organic Agriculture (EEC) 2092/91 the use of copper preparations for plant protection (e.g. Bordeaux Mixture) is allowed for a transitional period which will end at the 31st of March 2002. However, any use of copper preparations until 2002 has to be approved by the certification body. In case copper preparations have to be applied it is recommended to use preparations which contain less copper and therefore to reduce the accumulation of copper in soils (e.g. tribasic copper sulphate, copper hydroxide).

Pest /disease	Biological counter-measures
Helopeltis ssp. (Tea Bugs e.g. Tea mosquito bug)	In emergencies, neem extract[2]; encourage useful insects such as ladybirds; introduce *Bacillus thuringiensis*; in severe cases – pruning; always begin the harvest in non-infested sectors;
Oligonychus coffeae (Red spider mite)	In emergencies, neem extract, tobacco extract[3]; sufficient shade will suppress development; till weeds early enough before the main harvest begins;
Homona coffearia (Tea roller), an insect that can cause problems in India, Japan, Malaysia and particularly in Sri Lanka.	Plant a diversity of shading tree to attract e.g. parasitical wasps; Another natural antagonist is the Macrocentrus Hormonae parasite;.
Andrata bipunctata (Bunch caterpillar) *Biston surpressaria* (Looper caterpillar) *Etrusia magnifica* (Red slug caterpillar)	Counter-act with light traps; collect the caterpillars from the ground, tea bushes and shading trees (in all stages of development); Apply trap bands to the shading trees;
Brevipalpus phoenicis (Scarlet Mite) *Calacarus carinatus* (Purple Mite)	Suppress growth with green fertiliser plants and shading trees; apply lime and Soda washing in emergencies or after pruning.
Taeniothrips setiventris (Common Thrips; mostly in Darjeeling) *Scirtothrips dorsalis* (Assam-Thrips; mostly in Assam and Dooars)	Green manure plants and shading trees; lime and Soda washing; disturbing the soil around the tea bush stem during the cold months will destroy the pupae;
Moss (e.g. in Darjeeling during the winter months)	Wash the tea stems with lime and soda

[2] According to the European Regulation for Organic Agriculture (EEC) 2092/91 the application of Neem preparations is restricted and only allowed for the production of seed and seedlings. This regulation is discussed controversial. An up-date information is available from your certification body.

[3] According to the European Regulation for Organic Agriculture (EEC) 2092/91 the use of tobacco extracts is allowed for a transitional period which will end at the 31st of March 2002. However, any use of tobacco extracts until 2002 has to be approved by the certification body. Furthermore, application is restricted only for tropical and subtropical crops and shall be applied at the beginning of the vegetation period.

In principle, the "emergency measures", such as, e.g., neem extract, *Bacillus thuringiensis* cannot be used prophylactically – otherwise, the pests will rapidly become resistant. Measures involving copper preparations must also be used sparingly (and must be approved by the certification body beforehand).
After the tea bushes have been pruned, they need to be protected against infection. Natural waxes are used to protect the cut areas, and alkali solutions to wash off the lower tea branches (alkali solutions can be prepared from 6 kg soda, 2-3 kg lime and 100 Litres of water).
The tea bushes can also be pruned to counter pests and diseases, by cutting away infected branches ("knife cleaning").
The shading trees should be protected against aggressive insects with the use of trap bands (e.g. *Xylotrupes gideon* (Black beetle) and *Diacrisia oblique*, which are especially attracted to *Indigio teismanii*). On the one hand, shading trees can suppress certain pests, yet on the other, in some cases they can also act as host plants to diseases and pests.

2.7. Crop cultivation and maintenance

2.7.1. Pruning the tea bushes

Regular pruning of the tea bushes is one of the most important measures in cultivating tea. A variety of pruning intervals are practised, depending on the site and plucking system. Usually, the bushes are pruned back to a comfortable plucking height every three years, and then radically cut back every 15-20 years (to a plant height of 30-40 cm). Collar pruning, reaching down to the soil, is utilised to rejuvenate the tea plants.
No fundamentally different pruning measures are used to those carried out on conventional tea plantations. Yet it should be noted that the pruning interval will also influence the supply of organic material. Shorter pruning intervals with less pruned off will no doubt facilitate the decomposition of pruning material by the soil life.

2.7.2. Weed Management

Measures to suppress the growth of unwanted flora when beginning a new tea plantation have already been mentioned in chapter 2.3.. These also apply in principle to tea bushes after a rejuvenation pruning.
Mulching methods can be especially recommended to effectively combat weeds (and erosion-prevention). Hoeing is not recommended on those sites at risk from erosion. Motor scythes can also be used to make the job easier.

2.7.3. Fertilising with compost

Compost should be applied just before the main plucking times on the site. It is important to only work in the compost to a shallow depth, to avoid loss of nutrients. Greater amounts of compost (average 10t / ha) are generally applied after deep pruning.

2.7.3. Shading tree management

The shading trees need to be continually thinned out to create and maintain an optimum amount of shade (the pruning material should be used for composting or mulching if possible). Thinning out will also help prevent infestations of blister blight (*Exobasidium vexans*), which thrive under too shady (and thereby moist) conditions. The shading trees should be trimmed to prevent blister blight developing directly before the rainy season (monsoon).

2.8. Harvesting and post harvest treatment

Harvesting is invariably performed manually, which allows for a degree of quality control.
Independently of which harvesting method is used (orthodox method, CTC etc.), care must be taken to ensure that the produce does not become contaminated by foreign substances. It is important that the tea is not shipped open and unprotected.

Possible contamination sources include:

- Substances (e.g. copper, lead from abrasion) emanating from processing machinery that the tea comes into direct contact with,
- Wood protection preparations used to protect wooden crates (e.g. PCP),
- Glues used to make the crates (often containing formaldehyde)
- Glues used in consumer packages often contain contaminants (e.g. PCP)

2.8.1. Supplementary ecological measures

In addition to the erosion protection measures and measures to encourage settling of useful insects already mentioned (erosion from wind and water), emphasis should also be placed on gauging the availability of alternative sources of energy at the site. Generally, a considerable amount of the pruned material is used as fuel, whereby a large amount of nutrients are lost. The use of alternative sources, such as wind, water or solar energy or the manufacture of biogas, can offer some support at certain sites. The objective is to evolve agro forestry systems, as these are capable of producing large quantities of wood for building material and fuel, allowing prunings to remain on the plantation.

3. Product specifications

Tea is traded as black tea, green tea, Oolong tea and instant teas. The various processing methods are described in chapter 3.2.

- **Black tea**: Is fully fermented tea.
- **Green tea**: Through heat treatment (in pans or with steam), polyphenol oxidase (enzymes) in the fresh leaves are inactivated. Only then is the product rolled and dried (often frequently). Fermentation is suppressed by deactivating these enzymes, and the leaves retain their olive green colour.
- **Oolong tea**: The fermentation process is halted at an earlier stage partly fermented tea).
- **Instant teas**: Instant teas are made either from low-quality teas (fermented and dried), or from non-dried tea in a special process directly after fermentation. Instant teas lose much of their aroma during the extraction (only hot water extraction is permitted) and subsequent freeze-drying processes.

3.1. Minimum content levels

Contents

Dry matter	min.	93g / 100g tea
Extract contents	min. min.	32g water soluble constituents / 100g dry matter 26g water soluble constituents / 100g (for tea of Turkish or Russian origin)
Caffeine content	min.	1,5g / 100g dry matter
Total ash content	min. max.	4,0g / 100g dry matter 8,0g / 100g dry matter
Ash insoluble in hydrochloric acid	min.	1,0g / 100g dry matter
Water soluble ash	min.	45,0g / 100g dry matter
Raw fibres	min.	16,5g / 100g dry matter

3.2. Manufacturing black tea

A. Sorting

Aim: - To remove contaminants
- To remove old, dry tea leaves
- Fractionation of the flushes according to size

Tea sorting machines work according to the principle of the critical suspension speed.

B. Withering

B.1 Natural withering:
The fresh tea leaves are laid out in thin layers on tats stacked one above each-other, and dried in the fresh air.
Duration: up to 20 h (not terribly efficient)

B.2 Artificial withering:
The leaves are laid out in layers of up to 20 cm thick (ca. 23 kg/m²) on a mesh. The meshes are placed in a tunnel, through which warm air mixed with fresh air is forced. This considerably reduces the total withering time.

B.3 Drum withering:
The tea leaves are dried in perforated steel drums by warm, 55°C air that is blown through.

B.4 Tunnel withering:
Conveyance trucks laden with stacks of meshes are continually driven through a withering tunnel (4,5 m in length).
Duration: 2.5 h for 70% withering;
4.0 h for 65% withering

Around a third of the moisture content is extracted during withering (optimum residual moisture 60-62%). And the turgor pressure in the leaves is alleviated, leaving them soft and supple.

C. Breaking up

C.1 Rolling machines
A circular table fitted in the centre with a cone and across the surface with slats called battens. A jacket, or bottomless circular box with a pressure cap, stands atop the table. Table and jacket rotate eccentrically in opposite directions, and the leaf placed in the jacket is twisted and rolled over the cone and battens in a fashion similar to hand rolling.
Output: 455 kg/charge (20-30 minutes)

C.2 Rollbreaker
During the rolling process, the leaves can form relatively solid balls, which can be loosened and broken down in the rollbreaker.

C.3 Lawrence tea processor
The LTP is a combination cutting and hammer mill. The tea leaves are broken down by rapidly rotating knives and hammers. After the process, the tea is run through a bale shredder. LTPs produce 90% small-corn fannings or dust tea.
Output: 450-550 kg/h

C.4 CTC method (crushing, tearing and curling)

This machine consists of two seperated metal rollers, placed close together and revolving at unequal speeds, which cut, tear, and twist the leaf. CTC machines are widely used, for example, in Assam.

C.5 Rotorvane

This breaking-down machine works similarly to a mincer. Rotorvanes can be used to replace rollers, and are often used in combination with a CTC machine.

Output from withered leaves: 455 kg/h

Output from once-rolled leaves: 730 kg/h

C.6 Tobacco or Legg cutter method

The tea leaves do not need to be withered for this method. The leaves are first pressed into a cake form, and then cut up into strips. Afterwards, they are fed into a rollbreaker to be broken up and fermented.

Rolling makes the leaf cells burst, until the leaves are coated with juices and oxidation can take place with atmospheric oxygen. The air in the rolling room needs to have a relative humidity of 95% and be 20°C to 24°C, so that the juices do not dry out.

D. Fermentation

During fermentation, the oxidation process begun during rolling is continued. Fermentation takes place in separate fermentation rooms, which need to be kept extremely clean to avoid bacterial infection of the tea. The tea leaves are placed in 3.5-7.5 cm layers on aluminium trays. The thickness of the layers depends on the room temperature. As soon as the tea has acquired a copper red colour, the correct degree of fermentation has been reached, and the process must be halted by drying.

Temperature: 0-85°C (usually at 20-25°C)

Duration: 3.5-4 h for normal production processes

1-2 h for CTC and Legg cutting

E. Drying

The drying process generally consists of three to eight conveyor belts placed above each other, whereby the tea enters the dryer on the uppermost, and leaves the process on the lower belt. Hot air up to 90°C is blown against the leaves, which should have reached 80°C by the time drying has been completed, in order for the polyphenol oxidase enzyme to be properly inactivated. The moisture content should reduced to 3-5%, whereby the aroma becomes established and the leaves take on their typical black colouration.

Temperature: 75-85 °C

Duration: ca. 20 min

F. Sifting

Afterwards, the tea is fed through mechanical, vibrating sifter meshes in a variety (yet non-standardised) of diameters, and thereby graded into various particle sizes.

3.3. Maintaining quality

A. **Transport**

- Plywood crates lined with aluminium or plastic foils (PE) which are soldered or welded;
- Packaged on the same day,
- Air-tight sealing.

B. Storage

Packaging: Porcelain
Glass
Metal
Bags (paper - aluminium - paper)

A clear indication on the package that the originates from organic cultivation is needed to avoid any mixture with conventional tea[4].

Protects ag.:	Light	=> dark
	Heat	=> 5-20 °C
	Moisture	=> rel. humidity: 60%
	Smells	=> Air-tight sealing
Storage time:	1-2 years	

3.4. Flavouring of tea

The use of synthetic and/or naturally identical aromas is not permitted on principle in organic foodstuff. This is important to know, because flavouring of tea has a long tradition (e.g. the use of bergamot oil to make Earl Grey tea). However, the use of natural flavourings[5] is permitted. On the other hand, laying out layers of plant blossoms (e.g. jasmine) is permitted (the blossoms must be organically cultivated). In each case, the aroma substances used need to be approved by the certification body.

[4] When products from organic farms are being declared as such, it is necessary to adhere to the requisite government regulations of the importing country. Information concerning this is available from the appropriate certification body. The regulation (EEC) 2092/91is applicable to organic products being imported into Europe.

[5] The European Regulation for Organic Agriculture (EEC) 2092/91 defines that natural flavourings shall fulfill the requirements of the Flavouring Directive 88/388/EEC. Also the IFOAM Basic Standards define additional requirements for natural flavourings (see annex 4 of the IFOAM Basic Standards).